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The Development of Digital Technology to Support Learning in Children with Disabilities

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Abstract

This study was conducted with the following objectives: 1) to develop digital technology that supports learning in children with disabilities; 2) to test the effectiveness of digital technology used in children's learning. The sample selected to study the current context of and needs of digital technology consisted of a group of 46 teachers and parents. The sample group of children with disabilities who participated in the digital technology experiment comprised three children. The sample group who took part in the experiment in fieldwork comprised 45 children from nine types of disabilities; these were purposively sampled. The research instruments consisted of 1) ten easy-books with single vowels in Thai; 2) ninety individual implementation plans; 3) computer software to promote the reading of ten stories; 4) an evaluation form for children with disabilities' reading ability in Thai vocabulary in Prathom level 1; 5) a survey form for the current context of and the needs for digital technology to promote the children's learning; 6) an interview form for the current context of and the needs for digital technology to promote the children's learning. The data were analysed with the statistics of mean, standard deviation (SD) and efficiency assessment, using the E1/E2 formula with the 80/80 criteria. The research found that the effectiveness assessment value of digital technology to promote the children's learning was found at the rate of 86/90, which was higher than the standard rate.

Keywords: digital technology, learning support, children with disabilities

1. Introduction

At a time when many areas of life rely on technology, educational management inevitably emphasises the growth of digital technology, especially the development of technology that can help disadvantaged and disabled people access suitable kinds of education. This offers an opportunity for children with disabilities to receive the educational services the government provides to children without disabilities. Therefore, developments in digital technology should be supported and encouraged for children with disabilities, teachers, relevant people and educational personnel, who can access and select the appropriate digital technologies targeted to children with different types of disabilities.

1.1 Rationale and Significance of Study

Today, digital technology greatly impacts and inevitably affects society. With the widespread use of electronic devices like mobile phones and various kinds of communication tools, digital technology has changed how people live. Applications used online must be compatible with all models and brands of mobile communication devices, and should be quick and easy to use (Almara'beh, Amer, & Sulieman, 2015). In terms of education, Meesuwan (2016) found that the use of augmented reality technology in teaching helped learners to perceive things well through the five sensory organs, the eyes, the ears, the nose, the tongue and the body.

The use of digital technology is as important for children with disabilities as it is for children without disabilities (Botelho, 2021). Developments in digital technology by combining its processes with products, like a computer system with its function and interactions between user, machine and program, promotes teaching with the ability to store a large amount of data in a compact device for a long period, as well as facilitating its implementation. This leads to a better quality of life for children with disabilities (Botelho, 2021). This agrees with Sinthuwongsanont's study (2018) which referred to learners' quality of life and learning management in today's digital age. Advances in digital technology influence how people live today. Ways of living need to be adjusted to fit a context that has witnessed rapid and sudden changes, and this also affects learners' quality of life.

Therefore, digital technology should be used as a learning medium for all children, those with disabilities and those without, to help them access sources of knowledge. This will help them adjust to the learning and adapt to changes. Furthermore, in terms of advancement, this will also help children with disabilities enjoy life in a digital world and reduce educational inequality.

1.2 Relevant Concepts, Theories and Literature Reviews

Gerdruang's study (2017) on the promotion of learning in the 21st Century to support Thai society in the digital period, aimed to investigate the concepts of learning management in the 21st Century. The study was conducted by analysing and reviewing documents and studies from abroad related to 21st Century literacy and educational management in the digital period, with the aim of understanding the new frontier of learning. This study revealed that learning in the 21st Century consisted of four components: 1) digital learning; 2) creativity; 3) effective communication; and 4) productivity with high quality. The transition of learning from an earlier period to a digital one needs learning management that takes into consideration the relationship between study, work and ways of living, and which focuses on life-long learning management and promotes self-study with the maximum help of technology in learning management. Teachers guide learning according to the curricular specifications, with evaluation and assessment for development rather than achievement. Suttijak (2018) studied games of English vocabulary on mobile phones in the Android system for disabled children with a middle level of intelligence and found the following results. First, the experts viewed the quality of these games of vocabulary on mobile phones for disabled children with a middle level of intelligence as, on the whole, excellent. Second, the use of these games to memorise English vocabulary in five categories showed better than average results.

In summary, educational management in the digital era needs to focus on adjustment to changes, creativity in learning, and evaluation and assessment for development rather than achievement. Therefore, if digital technology is to be used to promote disabled children's learning, and to provide them with some necessary and appropriate opportunities for particular disabilities, it must deal with individual differences and bring value to these children and society.

1.3 Objectives of the Study

1) To develop digital technology to promote disabled children's learning.

2) To test the effectiveness of the digital technology used to promote disabled children's learning.

1.4 Keywords

Digital Technology for Disabled Children's Learning Promotion is defined as the digital technology that the researcher developed were easy-books with pictures, vocabulary in the story content, sounds and Thai Sign Language, as well as a manual of how best to use the digital system for particular disabilities. This consisted of ten stories, which were: 1) Nana Cooks; 2) Nong Noo Na's Family; 3) Tida and Her Friends; 4) Charlie Is Happy; 5) The Little Turtle on Taloo Island; 6) The Little Baby Pig; 7) The Joyful Mekong Giant Catfish; 8) The Buffalo and the Millipede; 9) The Perfect Ne; and 10) Let's Go to the Sea. These ten stories were arranged to promote reading skills in Thai at Prathom level 1.

Children with Disabilities is defined as children with disabilities, or disabled children, is defined as a child in one or more of the nine categories of disabilities according to the Ministry of Education Announcement on the Specifications of Types of and Regulations on Disabled People in Education, B.E. 2552, as follows:

(1) people with vision impairment

(2) people with hearing impairment

(3) people with intellectual disability

(4) people with physical or movement disability

(5) people with learning disability

(6) people with speech or language impairment

(7) people with emotional disturbance

(8) people with autism

(9) people with multiple disabilities

Children within these nine categories of disabilities were screened to see whether they would have disabilities or risks, according to the Office of the Basic Education Commission's criteria or the doctor's diagnosis, of being disabled and studying in Prathom level 1 in schools with special education, inclusive education, co-education,

formal and non-formal education or informal education.

Learning support is defined as the instructional management for children with disabilities, providing them with learning through digital technology with ten easy-books in Thai in Prathom level 1. This was developed by the researchers and supported, in terms of use, by their teachers, parents or mentors, with learning records, learning assessment and self-study. The activities were based on the practice and promotion of Thai reading skills of vocabulary with ten single vowels, for these disabled children to read both online and offline.

1.5 Expected Benefits

1) To gain the digital technology to develop and promote learning in disabled children within the nine categories, as mentioned above.

2) To develop digital technology that is effective in developing and promoting learning in disabled children within the nine categories.

3) To enable relevant organisations, teachers and educational personnel to develop and promote learning in disabled children within the nine categories.

1.6 State Hypotheses

Digital technology that is used to support disabled children's learning is sufficiently effective in promoting their learning of Thai at Prathom level 1.

2. Methodology

2.1 Population and Sample

1) Initial data about the current context of and needs for digital technology to promote disabled children's learning were collected from 46 teachers and parents, who were simply sampled.

2) The sample used to investigate the development of digital technology to promote disabled children's learning consisted of children using the experimental digital technology, namely three disabled children in Prathom level 1 from a co-educational school, with intellectual disability, learning disabilities and autism, respectively. The sample used for the fieldwork experiments comprised 45 children from nine categories of disabilities, who were purposively sampled.

2.2 Instrument

The data about the current context of and needs for digital technology to promote disabled children's learning were obtained from related literature, via the following steps.

The survey form of the current context of and needs for digital technology to promote disabled children's learning was developed, as follows.

1) Relevant documents were studied about how to develop the survey form of the current context of and needs for digital technology to promote disabled children's learning.

2) The survey form of the current context of and needs for digital technology to promote disabled children's learning, was developed with 30 items with a rating-scale in three areas: current instructional management, the application of digital technology for disabled children's current promotion, and the arrangement of learning environment to promote learning with digital technology.

3) The survey form of the current context of and needs for digital technology to promote disabled children's learning, was reviewed by five experts in terms of appropriateness, with the focus on IOC $\geqslant$ 0.5 value.

4) The survey form of the current context of and needs for digital technology to promote disabled children's learning was improved, and the sample was subject to experimental analysis.

The in-depth interview form of the current context of and needs for digital technology to promote disabled children's learning, was developed as follows.

1) The relevant documents were studied about how to develop the in-depth interview form of the current context of and needs for digital technology to promote disabled children's learning.

2) The in-depth interview form of the current context of and needs for digital technology to promote disabled children's learning, was developed.

3) The in-depth interview form of the current context of and needs for digital technology to promote disabled children's learning, was reviewed by five experts, in terms of appropriateness, with the focus on IOC $\geqslant$ 0.5 value.

4) The in-depth interview form of the current context of and needs for digital technology to promote disabled children's learning, was improved to be used with the sample group of 46 children for data collection, analysis and study summary.

The development of digital technology to promote disabled children's learning was conducted through developing the device and digital technology for easy-books, as follows.

1) Data obtained from the survey and interviews about the current context of and needs for digital technology, was used to develop the easy-book technology for disabled children in Prathom level 1, with ten stories with ten single vowels.

2) Illustrations were drawn. The storyboard was made and transformed into the Thai Sign Language.

3) The functions of the computer system, such as signing in, using and emphasising vowels as important vocabulary parts in the stories, were specified according to the Core Curriculum of Basic Education, B.E. 2551, Thai Language, Prathom level 1. Then, individual implementation plans were arranged.

4) A focus-group discussion with 14 experts was arranged to consider appropriate content and structure of the ten stories, the individual implementation plans, and functions of the digital system, with an appropriacy value of the easy-book digital technology at the rate of .80.

5) The easy-book digital technology was adjusted according to the experts' suggestions before being transferred into computer systems both online and offline, as specified by the researcher.

6) Initial experiments with the easy-book digital technology was done with three voluntary participants, who were disabled children, with parental consent.

7) The data were collected and analysed with basic statistics.

3. Results

3.1 Statistics Used for Data Analysis

The statistics used for data analysis consisted of mean and standard deviation. Then, the results were summarised. Data from the focus-group discussion were also analysed and summarised as descriptive information.

3.2 Findings

The data would be presented regarding the research framework, as follows.

1) Results of Current Context of and Needs for Digital Technology to Promote Disabled Children's Learning.

Table 1. Information about current context of digital technology to promote learning (N=46)

No.	Areas of Instructional Management	Current Context of Digital Technology to Promote Learning			Needs for Digital Technology to Promote Learning		
		$\bar{X}$	SD	Interpretation	$\bar{X}$	SD	Interpretation
	Instructional Management of Reading	2.13	0.64	moderate	4.04	0.10	a lot
	Application of Digital Technology with Learning	1.92	0.70	a little	3.71	0.53	a lot
	Arrangement of Learning Environment	2.62	0.78	moderate	4.66	0.38	most
	Total	2.11	0.70	a little	3.98	0.36	a lot

According to Table 1, it was revealed that the current context of the use of digital technology for disabled children's learning was in the low and medium level, and that the needs for digital technology to support disabled children's learning were in the high and highest levels, with the overall result in the high level at the rate of $\bar{X} = 3.98$.

2) The development of the easy-book digital technology was produced with data from Step 1 and document reviews to identify the Thai vocabulary in Prathom level 1 used for the ten stories with single vowels. Afterwards, illustrations were added, and the digital technology was developed with 1) ten stories with ten single vowels; 2) ninety individual implementation plans; 3) a manual to apply easy-book digital technology; 4) a software program for online and offline use with the following specifications.

1) Access Suan Dusit University's website: http://www.dusit.ac.th.

2) Click the menu of "Online Learning Resources".

3) Select the banner of the "Special Education" service, to enter the lesson.

4) Steps of Application, having entered the program, click the button, click the button "Go to the lesson", to sign out, click the 'X' button.

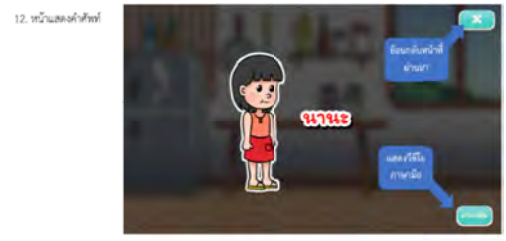

Figure 1. Steps of easy-book digital technology application

3) The effectiveness evaluation of the easy-book digital technology was analysed with the help of the E1/E2 formula with the 80/80 criteria.

Table 2. Scores gained from initial use (N=3)

Students	Before the Study (50)	During the Study (50)	After the Study (50)	Difference of Pre- and Post-Study (D)
1	16	44	46	30
2	15	43	45	30
3	14	42	44	30
Total	45	129	135	90

According to Table 2, the three pupils received low-level pre-study scores. After the study, the test showed that the three sample pupils achieved scores at very high levels. In terms of difference, their pre-test and post-test scores were evidently different. Their total score from the pre-test was 45 points while the total from the post-test was 135 points, a difference of 90 points. When the scores of the pre-test and the post-test were analysed, using the formula designed by Promwong (2020), the effectiveness value was shown in the high level, at the rate of 86/90. This implied that the easy-book digital technology was effective enough to promote disabled children's learning.

4. Discussion

4.1 Discussion from Finding

According to the study's findings, the easy-book digital technology could be developed to promote the learning development of Thai among disabled children in Prathom level 1. It was apparent that the sample group could learn Thai vocabulary from the stories they read. They could learn the vocabulary and understand its meaning, which resulted in different scores before and after study. This showed that the easy-book digital technology was easy for these disabled children to access, and helped promote their reading development in Thai. This aligns with Hongngam and Polrachom's (2021) study on the developmental package for promoting development of children with dyslexia in early stage, which investigated the development of computer games in promoting disabled children's reading. This study disclosed that disabled children's reading could be promoted to a higher level with computer games and multimedia. The research study revealed that the sample group was satisfied with the illustrations in the media due to beautiful colours, and it was fun and engaging without being boring, which was different to learning from books in general.

Digital technology in the form of multimedia makes learning information accessible and can foster reading development. This is congruent with Greer, Crutchfield, and Woods (2013); they describe another technique that can aid in the learning of students with disabilities is to apply technology to learning and processing information. This is a hybrid of educational technology and media aspects that facilitate learning. That's a multimedia lesson in which computerized information is presented with text, graphics, audio and video. It generates interactive feedback, which is one of the reinforcements that drive learning in the learner (Kalyuga, 2013). It is also in line with studies of Omar and Bidin (2015) and Takacs, Swart, and Bus (2015) they point out that the current use of technology to advance learning needs to integrate a diverse media that has a variety and looks intriguing in order to attract learners to focus on what interests them. This leads to effective concentration in learning and self-development, particularly in students with disabilities who use multimedia. It has a greater favourable influence on reading when using media containing visuals and text. Multimedia is a decent way to translate the abstract into the concrete, which is accessible and encourages students to learn at their own pace. Therefore, it is a tool for transferring learning between teachers and students to achieve maximum efficiency. It also aligns with previous research into the development of computer games to improve deaf reading, which revealed that improving students with disabilities reading through the use of computer games built with multimedia media can promote reading (Prachumwan & Thirakote, 2014). Furthermore, Setiawan, Nugroho, Kusnendar, and Wibawa (2018) discovered that using multimedia enhances disabled students-reading skills due to its colorful illustrations and entertainment, as opposed to tedious learning via books.

It can be concluded that digital technology could be used promote disabled children's learning. This was formulated through the processes of research and development initiated with the needs of the children, teachers and parents. Data were obtained from the survey and interviews about the current context of and the needs for digital technology to foster learning in disabled children, from the survey form's 46 respondents, from the focus-group discussion, and from comments from relevant specialists. In summary, there were suggestions about the appropriate development for particular categories of disability. Then, the researchers synthesized the data and developed instructional media for Thai reading in the form of easy-books with ten stories and ten single vowels to suit the needs of disabled children studying in Prathom level 1 at co-educational schools. Initial experiments with the media focussed on three disabled children to assess their initial effectiveness value. With the

effectiveness value at a high level, these media were later trialled in fieldwork with 45 children from nine categories of disabilities and were considered highly effective. Besides its ability to help disabled children learn vocabulary, the digital media also helped the children to practice speaking, communicate, and tell stories related to their daily lives. Consequently, it can be concluded that this digital technology, focused on children, was beneficial to all children whether or not they had a disability, as well as their teachers and parents. It could be used to support disabled children both in class and out of class, to practice Thai-language skills, and be used to assist children's continuous learning due to its up-to-date contents. In particular, in the current situation with the spread of Covid-19, pupils who need to study online can revise their lessons with this technology, improving their knowledge of Thai. There is evidence that disabled pupils take pride in themselves and become more self-confident to acquire knowledge freely via reading.

4.2 Suggestions

1) Digital technology that supports disabled children should be used with pupils in all schools to promote their learning.

2) Data about each child should be analysed to find their strengths and weaknesses. This can be used promptly to help a child and respond to learners' needs in-depth.

3) A digital technology website should be published so schools across the country can use it to encourage their pupils' learning of Thai, both online and offline.

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